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2. Patent application number *(The Patent Office will fill in this part)*	0314680.0
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	Thomas Henry Bell 33B St Catherine's Road PERTH PH1 5SA
Patents ADP number *(if you know it)*	06285282003
If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom
4. Title of the invention	Improved valve system
5. Name of your agent *(if you have one)* "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Kennedys Patent Agency Limited Floor 5, Queens House 29 St Vincent Place GLASGOW G1 2DT
Patents ADP number *(if you know it)*	08058240002

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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a) any applicant named in part 3 is not an inventor, or
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11. I/We request the grant of a patent on the basis of this application.

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Date 24.06.03

12. Name and daytime telephone number of person to contact in the United Kingdom — Claire Rutherford TEL: 0141 226 6826

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Improved Valve System

The present invention relates to a new type of valve system. In particular, it relates to a valve system which can be used to control a cistern or water tank filling, or control inflation devices.

One of the most common valves in use in the home today is the ball float valve which can be found in practically every home that contains a flushed WC or a storage system. Although there are different ball float valves on the market, the majority of differences between the valves are purely aesthetic. Although the initial cost of the ball float valve makes it a practical device for controlling water levels in the cistern, there are a number of problems with the valves that up until now have not been addressed. Firstly, maintenance of the valves after a period of time can be expensive, especially if replacement is required.

Another common problem with ball float valves is their failure, resulting in the external overflowing of water,

which can cause structural damage if not checked in time, in addition to a waste of energy and water.

Yet another important problem with ball float valves is that the length of the arm and ball can restrict the size and shape of the vessel into which it is fitted, this is particularly noticeable in the case of flushing systems. The fittings attached to a WC, such as the handle for flushing, and a siphon also must be arranged in a set position to accommodate the valve.

As mentioned above, some manufacturers have tried to address these problems by redesigning the ball and lever position to work within the vertical plane of the valve. Another method is to use an equilibrium type valve which has a shorter ball and lever. Nevertheless, the general problems still exist in all of these amended valve types.

Ball float valves are automatic in action, with the principal design involving the use of a buoyancy float at the end of a lever, exerting its upward force on the end of a piston or similar device to close the orifice from which water is flowing. Currently on the market the only alternatives are water storage vessels that have been fitted with special control valves, such as motorised valves, or WCs fitted with flushing valves. These alternatives can be expensive and in many cases have to be supplied from a storage system that also uses a ball float valve. All ball float valves are graded in accordance with the water pressure they are required to withstand and the orifice through which the water flows. A whole array of valves are available to cope with the different water pressures, to ensure the reasonable

supply of water to a cistern. The main type of ball float valves available on the market currently are high pressure, low pressure, full-way and equilibrium valve.

In a high pressure valve, the orifice will be proportionally smaller than a low pressure valve with the same rate of flow. Whereas, in a full-way valve, which is installed where low pressure flow rates exist, there is a larger orifice than that of a low pressure valve. Conversely, a high pressure equilibrium valve works on the principle that it transmits equal pressure to either end of its piston, such that the buoyancy of the ball does not have to withstand the pressure on the piston. Therefore, a larger orifice can be proportionally larger to that of a high pressure valve.

It can be seen that it would be beneficial to be able to provide a new type of valve system which does not suffer the same restrictions as the ball float valve system, but which can be used to control water levels in a similar manner.

It would also be useful to provide a new valve system which is able to control other fluid levels as well, such as air levels. This could be particularly useful in situations such as flood barriers, wherein when the water level rises, an increase in air pressure can be used to inflate a flood barrier.

A yet further object of the present invention is to provide a valve system which does not face all of the limitations associated with typical ball valves.

According to a first aspect of the present invention, there is provided a valve system which comprises:

- a first chamber; and
- a compression tube which leads into the first chamber

wherein the compression tube contains a first fluid and a second fluid, and wherein an increase of the second fluid in the compression tube compresses the first fluid, resulting in a transposition of pressure into the first chamber.

Preferably the first fluid is air.

Preferably the second fluid is water.

Preferably the compression tube comprises water level adjuster holes.

Preferably the water level adjuster holes are provided with a removable seal.

Preferably the removable seal is in the form of a moveable sleeve.

According to a second aspect of the present invention, there is provided a valve, as described in the first aspect, that can be used to regulate water levels in a system.

Preferably the first chamber contains a diaphragm valve, which itself comprises a flexible material.

Preferably the diaphragm valve further comprises a plunger section.

Preferably the first chamber is separated from a second chamber by an inlet hole.

Preferably the plunger is aligned with the inlet hole.

Preferably when pressure applied to one side of the diaphragm valve, it will move to block the inlet hole leading to the second chamber.

Preferably the second chamber is separated from a third chamber by a flexible diaphragm.

Preferably the third chamber comprises an inlet.

Preferably the third chamber comprises an outlet.

Preferably the outlet is a water outlet.

Preferably the outlet leads to a cistern.

Preferably the flexible diaphragm contains a metering hole through which fluid can flow.

Preferably the flexible diaphragm comprises a blocking means.

Preferably the blocking means is a washer.

Most preferably when there is an increase in pressure in the second chamber, the diaphragm moves such that the blocking means blocks the inlet in the third chamber.

Preferably the valve system is provided with an automatic cut-out, which itself comprises water absorbent material housed at a position within the diaphragm valve.

Preferably, in the presence of water, the water absorbent material will increase in volume, pushing the diaphragm valve to block the inlet hole.

Optionally the valve system may comprise an adjuster which is able to alter the pressure required to close the valve, wherein the adjuster comprises a compression means which is able to selectively compress the diaphragm valve, thus altering the resistance of the diaphragm valve.

Preferably the compression means comprises a screw and a spring, wherein the screw can be turned to compress the spring, which then causes resistance on the diaphragm, forcing it further away from the face of the inlet hole.

According to a third aspect of the present invention, there is a provided a valve system (as described in the first aspect) that can be used in a flood defence system.

Preferably the first chamber contains an inflatable element.

Optionally, the inflatable element may be provided in a different chamber which is attached in some manner to the first chamber.

Most preferably when the pressure in the compression tube increases, the inflatable element inflates.

Most preferably the pressure in the compression tube will increase when water levels rise in the compression tube.

Preferably the compression tube is placed within a body of water and the inflatable element is positioned above or on top of the body of water.

In order to provide a better understanding of the present invention, an embodiment of the invention will now be described by way of example only and with reference to the following drawings, in which:

Figure 1 shows a Portsmouth equilibrium float valve which is part of the prior art;

Figure 2 shows a diaphragm equilibrium float valve which is part of the prior art;

Figure 3 is a diagram of the new valve system according to the present invention for use in regulating water levels, i.e., in a standard flushed WC;

Figure 4 shows a pressure spring adjuster which may be part of the new valve system according to the present invention;

Figure 5 shows a compressor spring adjuster which may be part of a new valve system according to the present invention; and

Figure 6 is a diagram of a new valve system which can be used as an automatic flood barrier according to the present invention.

Working Principles

In order to fully understand the working principles behind the new valve system, it is important to understand force and water pressure.

Water pressure acting on the base of a tank is proportional to head and volume of liquid does not affect pressure. For example, the pressure at the base of the tank holding $1m^3$ is the same as a tank holding $10m^3$ with the same head of water. However, the force acting on the base of a large tank is greater. Also, it should be noted that if the base is less than $1m^2$, then the force will be less.

In the new valve system, one aspect of the invention is concerned with the closing off of incoming water to any cistern or tank without the use of a ball float valve and lever. The design utilises the fact that an alternative pressure can be exerted to close the orifice from which water is flowing and in fact, if required, a much greater pressure can be achieved. By experimentation, it was found that by placing a manometer tube into a tank, the head of water at the base of a tank will register a head of water on the manometer, even if the manometer tube is held above the tank. This effect occurs because the

force of the water at the base of the tube transposes the water pressure via the air in between the two water columns. However, it should be noted that to register nearly the same bottom tank pressure on the manometer, the volume of air between the tube must be of such a capacity that this transposition takes place with a minimal loss of registered pressure head. Therefore, too great or too little a volume of air in-between the tubes would result in the prevention of any significant movement of water in the manometer. As it is known that a fixed mass of air or any gas at a constant temperature is always inversely proportional to the pressure (according to Boyle's Law), the volume of air in between the water and the tank and the manometer can be calculated to maximise the transposition. For example, if the volume of air in a tube is halved, the pressure is doubled, and vice versa.

An example of the principles in action is shown below.

Where P = absolute pressure = 101.33kpa, V = volume, C = constant and P1V1 = P2V2 (the application of this equation enables a difference in volume to be determined).

In order to find the pressures of air in a tube and confirm the pressure head, the following calculation can be carried out. The initial volume of the tube is $\prod r2h$ = 3.142 x .006 x .006 x .480m/m = .0000542m^3. When water is added to create a pressure head of 300m/m, the upthrust due to the pressure reduces the height of air within the tube by 15m/m. This volume can be calculated as follows:

$3.142 \times .006 \times .006 \times .480 - 15\text{m/m} = .0000525\text{m}^3$

$P1 = 101.33$
$V1 = .0000542$
$V2 = .0000525$
$P2 = ?$

Where $P1V1 = P2V2$, then $P2 = \dfrac{P1V1}{V2}$

Which $= \dfrac{101.33 \times .0000542}{.0000525}$

Which $= \dfrac{104.66 - \text{gauge } 101.33 = 3.82\text{KN pressure in tube}}{9.81}$

Which = .334m/m approximate pressure head

By experimentation, it was found that only 5% of pressure head was lost when 300m/m head of water was applied. This is due to the upthrust pressure of the water in the inner tube, compressing the air until the pressure equalises with the applied water pressure. When the pressure head is reduced to half, the upthrust is proportionally reduced.

When the volume of air within the tube is increased to 960m/m, the percentage of upthrust is increased, reducing the pressure head.

Moreover, sealed tubes of different diameters but similar lengths inserted into the water vessels for the same

pressure head will produce the same upthrust (as explained previously).

However, although a force of water can be transposed from the base of a tank to the upward area to nearly equalise against the similar force, in practice the pressure head within a cistern acting on the base would generate an insufficient force to act on a piston or similar device to close an orifice from which water is flowing. However, by acting the force on a larger area, this would produce an adequate force to act on the piston or similar device to close the orifice. This is because the greater the area, equals the greater the force.

The fact that water or air pressure equalises in all directions, means that the transposition of water pressure by air from a much small area to a larger area will greatly increase its force. However, it should be noted that the air volume must be of certain cubic capacity to maximise the pressure.

The new valve system operates as there is a correlation between the size of the diaphragm and the pressure head available, i.e., the greater pressure head, the smaller the diaphragm, the smaller the pressure head the greater the diaphragm. In the present invention, due to variable water pressures and different markets, the cistern will be arranged for an option in size for the domestic market, but can be proportionally altered to be adapted for industrial uses, etc.

Example of the New Valve System

Figure 3 shows a figure of the new valve system for use relating to closing off automatically any incoming water to a cistern or tank. The water enters the new valve system 1 through the inlet tube 14a. It is unimpeded in flow when the valve system 1 is open. The water flows through the inlet tube 14a into the third chamber 13 and fills the cistern through the outlet tube 15. At the same time, water flows into the second chamber 11 through the metering hole 16 incorporated in the flexible diaphragm 14b. The water in the second chamber 11 seeps out through the inlet hole 12 into the first chamber 2, which prevents any build up of pressure in the second chamber 11. This results in the pressure on either side of the flexible diaphragm 14b being equalised, resulting in no movement of the flexible diaphragm 14b. In this state, the new valve system 1 is fully open.

However, as the cistern fills with water, it covers the compression tube 3 and any adjuster holes 6 that have not been covered by a removable seal 7. A pressure head of water starts to build up in the compression tube 3, compressing the air within the compression tube 3. When the water level reaches a predetermined height in the cistern to generate sufficient pressure, it acts on the diaphragm valve 8. In the preferred embodiment there is a surrounding cage around the diaphragm valve 8 which prevents any back pressure occurring, such that the valve 8 extends forward, such that its plunger 10 is compressed against inlet hole 12, closing the water seepage off. When this occurs, pressure within the second chamber 11 builds up until it equalises with the incoming water pressure which causes the inner flexible diaphragm 14b to

move forward, closing off the water from the inlet tube 14a. In this state the valve is fully closed.

When the water level in the cistern falls, the pressure in the compression tube is reduced, which automatically results in the diaphragm valve 8 moving back, opening the inlet hole 12, such that water seepage again occurs from the second chamber 11 into the first chamber 2, and the flexible diaphragm 14b drops back into position, such that the inlet tube 14a is no longer blocked by the blocking means 17.

Slide Sleeve Water Level Adjuster

In order to adjust the pressure required to close off the valve system 1, the compression tube 3 may have a series of level adjuster holes 6 drilled into it at different levels. The level adjuster holes 6 are coverable with an outer removable seal 7. When this removable seal 7 is move up, it exposes a level adjuster hole 6 and breaks the pressure head allowing more water into the cistern before the diaphragm valve 8 activates. When the removable seal 7 is pushed down, it allows less water into the cistern before the diaphragm valve 8 activates.

Compression Spring Adjusters

Figure 4 shows an alternative adjuster that can be fitted to change the amount of water required to activate the diaphragm valve to close off the new valve system 1. These type of compression spring adjusters can be mounted at any position but usually either on top of the body of the new valve cistern 1, or in a central position, as illustrated in Figure 4. To adjust the water level, the thumb or adjuster screw 19 is turned to compress the

spring 18 which causes a resistance on the diaphragm valve 8, forcing it further away from the face of the inlet hole 12. Therefore, more water has to enter the cistern to build up a greater pressure head to push the diaphragm valve 8 forward further to close the inlet hole 12.

Automatic Cut-out

An automatic cut-out can be included in the new valve system 1 to ensure that if the new valve system 1 fails, and the water levels in the cistern rise to an undesirable level, an automatic cut-out will occur. Figure 5 shows a diagram of the automatic cut-out system. The automatic cut-out consists of a number of water absorbent washers 20 housed in a cup-type chamber 21 positioned in the diaphragm valve 8. If, during operation, the new valve system 1 fails and does not cause the diaphragm valve 8 to push forward to close the inlet hole 12, water would automatically enter the first chamber 2 behind the diaphragm valve 8. If this occurs, the water absorbent washers 20 housed within the chamber will automatically increase in volume due to water absorption. This increase in volume will force a cut-out plunger 22 attached to the water absorbent washers 20 to move forward, pushing the normal plunger 10, such that it closes the inlet hole 12. In this manner, any overflowing or wastage of water will be prevented, even if the new valve system 1 fails for any reason.

Alternative Embodiments

Although the new valve system can be ideally used to regulate water flow in a cistern, as described in the preferred embodiment, it also has a number of other uses.

Figure 6 shows a diagram of another possible use for the new valve system 1, as an automatic flood barrier. It can be seen that as in the previous embodiment there is a compression tube 3 and level adjuster holes 6 and a removable seal 7 can be included, if required. The compression tube 3 leads to your first chamber 2, which itself incorporates a flexible material 9. However, instead of the flexible material 9 being in the form of a diaphragm valve 8, as in the previous embodiments, the flexible material will inflate in response to an increase in pressure in the compression tube 3. It can be seen that the flexible material does not necessarily have to be in a first chamber, but may be in a second, third or fourth chamber, etc., which is joined to the first chamber in some manner. If this system is used in a river, the compression tube 3 will be used on the river bank with the first chamber 2 incorporating the flexible material 9 being present on the riverbank. As river levels rise, water will enter the compression tube 3 at higher and higher levels, causing the flexible material 9 to inflate in response to the pressure increase within the compression tube.

Another embodiment would use the valve as a containment barrier for oil spills and such the like. In this embodiment again the compression tube 3 leads to a first chamber 2, which itself incorporates a flexible material 9. When dropped into a body of liquid such as the sea around the periphery of an oil or chemical spill the flexible material will inflate to form a containment barrier. The compression tube and any internal valve units (if required) will be prepared such that as soon as

the compression tube 3 is place in position the pressure would be sufficient to immediately inflate the barrier.

It can be seen that the valve system has a number of advantages over prior systems, in that it can be manufactured in a compact manner, it is easy to install and use, and maintenance costs should be relatively low.

The embodiments disclosed above are merely exemplary of the present invention, which may be embodied in different forms. Therefore, the details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and for teaching one skilled in the art as to the various uses of the present invention in any appropriate manner.

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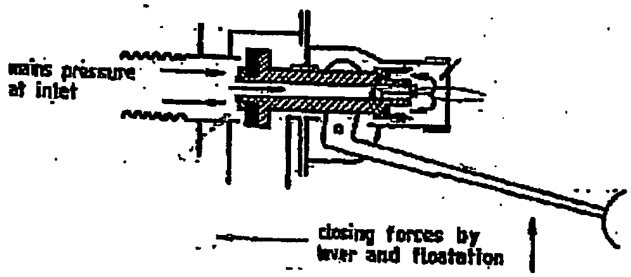
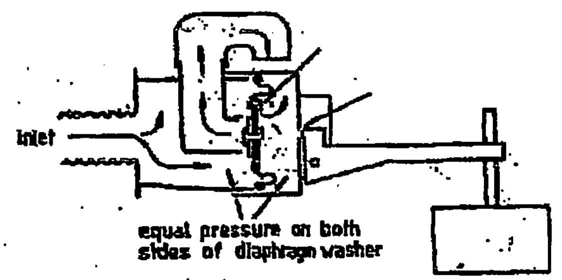


Figure1



Figre 2

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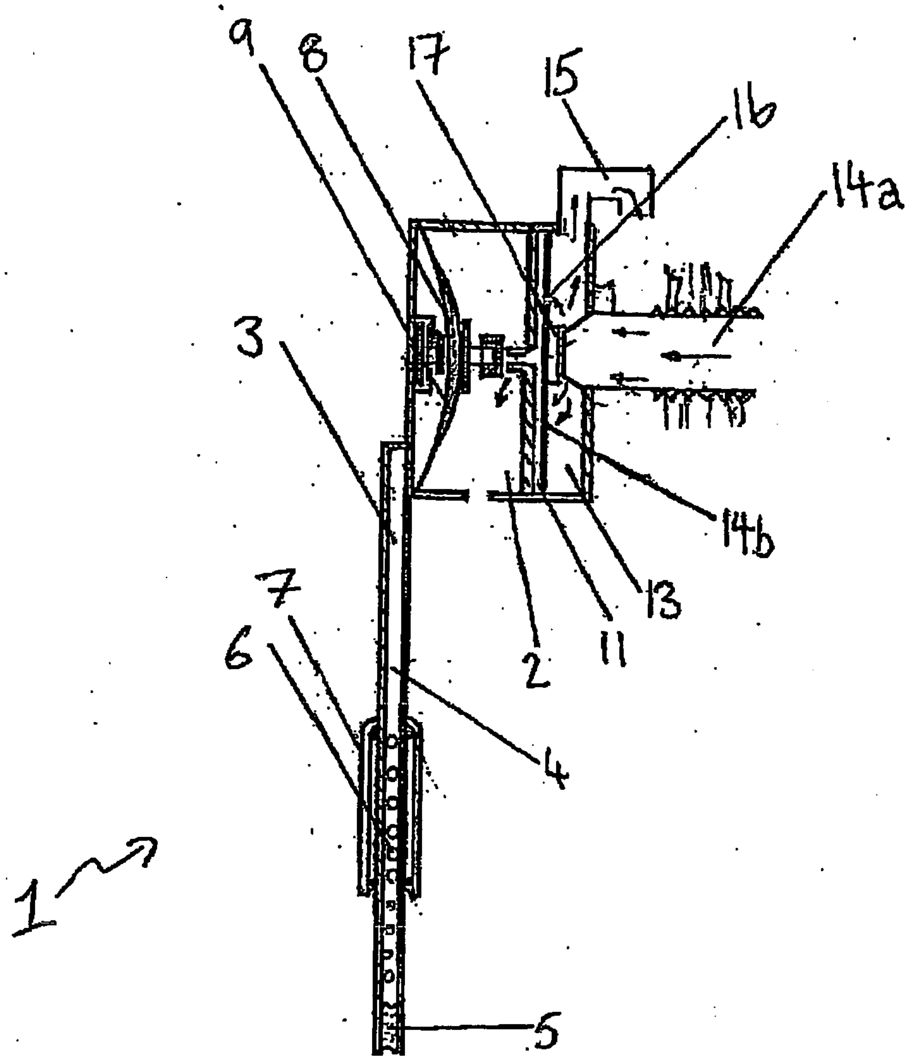

Figure 3.

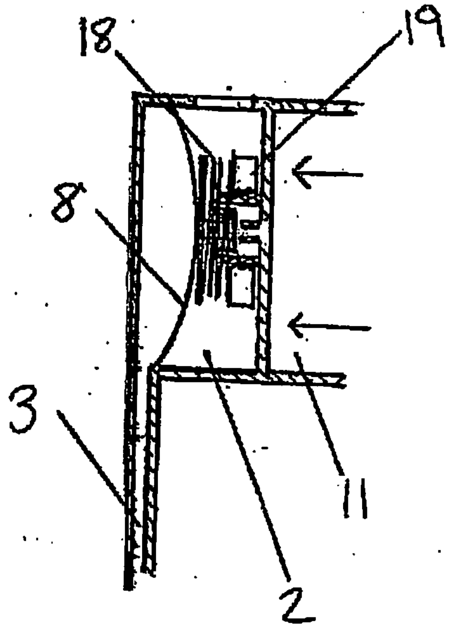

figure 4

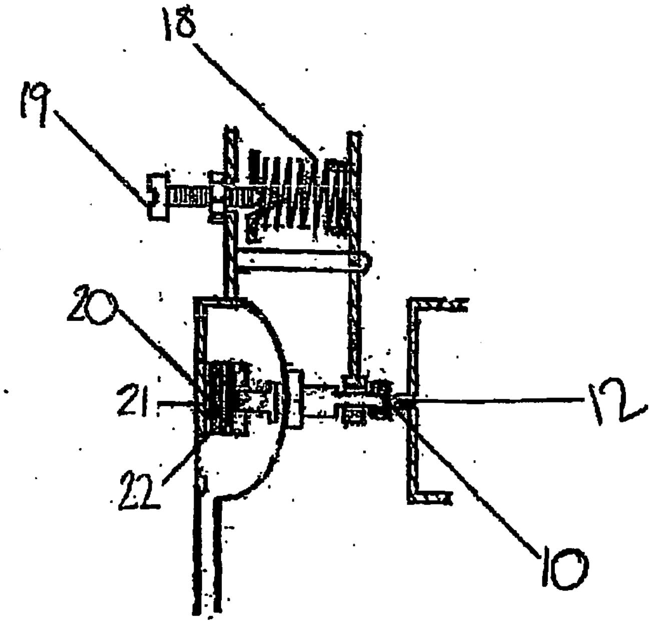

Figure 5

4/4

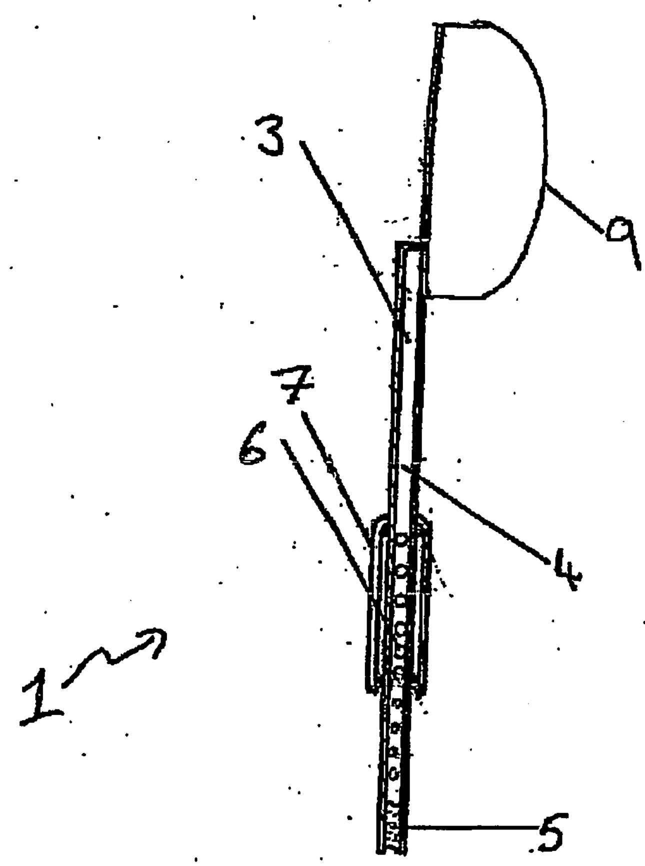

Figure 6

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